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COMMERCIALIZATION OF RESEARCH RESULTS OF SRI LANKA*

by

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General

Commercializing of research results is generally a more difficult task than the marketing of the products resulting from the research. In general, factors which influence marketing of the product more or less will decide whether the research results should be commercialized. In many instances where there is a favourable market for the products coming out of the research results, it might happen that the development stage of the project falls short of the industries expectation, specially when the industry is ill - equipped to complete development work. In a business climate where interest rates are high and economic planning is de-emphasized, industrialists tend to concentrate on quick yielding projects and shy away from introducing new products. This situation is further aggreviated in most developing countries where the economic planners are insulated from the pressures of the business environment and are insensitive to the risks involved in launching new products. They fail to appreciate that in most cases where the products are commercially successful, benefits accruing to the consumer out-weighs the benefits to the innovator, a fact well documented by Mansfield.

Whether the research result in a process or a product, and whether it falls into the consumer domain or the industrial domain, will determine the strategy to be adopted in the commercialization phase. It is not possible to say that a particular strategy is correct or incorrect. We can say that the strategy in general is successful or unsuccessful. The strategy an organization will adopt is also influenced by its own capabilities and outlook. The organization may opt for a mode of commercialization minimising its involvement and effecting earliest transfer of technology. Another organization may well try to maximise benefits from the new technology so as to ensure the greater good of the greater number. Where the technology enables the satisfaction of a basic need being denied to the majority-due to the high costs of the product or service,available with the technology in current usage-the consumers' low purchasing power and their high expectations are often major obstacles to successful commercialization.

In such a situation profit margins tend to be low while the marketing costs tend to be high. Therefore established businesses will usually avoid such projects. The established businesses prefer to service either industrial customers or the high income group rather than to service the masses having low disposable incomes. If you live in a country like Sri Lanka with a per capita income of only $300 per annum, opportunities available for such highly profitable quick yielding projects are very limited, especially considering the population's obsession for imported goods liberaly available in an "Open Economy". No wonder then that most businessmen prefer to engage in trade rather than engage in manufacture and there is an acute lack of bankable projects according to local development banks. The trend in modern technology development is for mass production and automation. With the existing low level of technical capability within the country, and the small size of the market, local manufacturers find it impossible to reach economics of scale achieved by the foreign giants. Even a 50% tarriff protection is quite often insufficient to protect such local industries.

Link Mechanisms between Research and Industry

Most manufacturing industries in developing countries like Sri Lanka have to fight hard to maintain their status-quo. Their planning horizon does not extend more than one year and in many cases it covers only one month ahead. In the face of falling demand due to inevitable changes in the product life cycle and their inability to introduce viable new products consistant with their manufacturing capabilities, most manufacturers turn to trading activity as an alternative to manufacturing. In countries like Sri Lanka where special priviledges are accorded to foreign joint ventures, local businessmen would jump at a foreign proposal, whereas a similar proposal from a local party would be held in disdain. This unhealthy situation is not because of a lack of linkages between industry and research institutions but more due to differences in their objectives and outlooks.

It is the avowed objective of industry to make profits. As almost all the research institutions in developing countries like Sri Lanka are public sector institutions their objectives are seldom profit oriented. They are supposed to further the national development in the long term and to solve technical problems of the state sector and of the less priviledged business organizations. This is based on the idea that large established businesses should not be provided subsidised services by state research institutions since they should be in a position to undertake such activity by themselves. Developed countries like Japan and U.K.,in general,favour basic research to be done by state institutions and the more directed and industry specific research to be done by research institutions sponsored by trade associations. It is unfortunate that business entities in most developing countries like Sri Lanka where small market size results in severe local competition, hesitate to co-operate together to improve their lot. On rare occasions where trade associations do exist their activities are restricted to such administrative matters as import quotas and tarrifs and to common marketing programmes such as exhibitions. If their members come across research results that would help raise the level of industries performance such results are rarely passed on to the association to be circulated to the membership. In 1976 the NERD centre in association with the Industrial Development Board of Sri Lanka was instrumental in forming the Foundry Association of Sri Lanka. During this period import of foreign machinery was restricted and the local foundaries had plenty of work. The question of import quotas and duties for imported foundry coke dominated much of the business meetings of the association. After surveying the different products made by members of the association a project was started to improve the quality of the locally manufactured sugar cane crushers since there was a heavy demand for such a crusher due to the prevailing high prices for sugar cane jaggery. The NERD centre in colloboration with the Foundry Association organized a number of seminars for improving current foundry practices and to establish better manufacturer-customer rapport. Unfortunately by 1978 the sugar cane jaggery market crumbled and local sugar cane crusher manufacturing completely ceased with the liberalized import of foreign crusher machinery. Today the Foundary Association has ceased to exist and only a few of the foundaries are still in operation.

Consultancy is a common and import link between research institutions and industry. In small developing countries like Sri Lanka the few existing research institutions have to spread their resources over a very wide field, and as such lack the depth and expertise a particular industry may require for a specific job. Further,unless the matter is extremely urgent the industrialists prefer to call consultants from abroad usually from one of their associated companies or from their equipment suppliers. With the high incidence of foreign joint ventures the number of foreign consultants in the country is very large and involves a large commitment of funds, a large proportion of which is paid out in foreign exchange. Industry and the government has so far failed to appreciate that the building up of a cadre of local consultants is essential to local technology development. Not only will the country save enormous sums in foreign exchange paid to foreign consultants but also the gains from the "learning by doing" process will benefit future projects. A special handicap faced by public institutions engaged in consultancy work is that the customer is reluctant to pay for such services expecting them to be provided free by the public sector institutions as a service from the government. This is a major draw-back in trying to improve the quality of locally produced goods since it is difficult to convince the budding industrialist that he needs technical assistance in addition to which he has to find the money to pay for it. In spite of its draw-backs the links resulting from consultancy work are important to appriase industry of the work of the research institutions, and serve as a source of feed back information both in initiating new research projects and in setting priorities for existing projects.

Some research institutions are in a favoured position in that they perform certain services to fulfill statutory requirements like quality control certification etc. Contracts so established will gradually lead to fruitful co-operation in the future. Sponsored research is another important link mechanism existing between the research institutions and industry. The usual arrangement is for industry to fully or partly finance a particular research project conducted by the research institution. Depending on the covering agreement the research results would be made available only to the sponsoring partly or held confidential for a limited period and in other cases are made available to the public on the payment of a fee.

Sponsorship of research could well be in the reverse direction where part or the whole research work will be conducted by the industrial collaborator. Between 1975 and 1977 the NERD CENTRE also operated such a scheme of awarding research contracts to individuals or industrial institutions. The cost was met fully or partly by the NERD Centre which retained control of the use of the research results on an exclusive or a non exclusive basis depending on the circumstances. In 1972 when NERD Centre moved to its present premises and were able to acquire the necessary facilities contracting out research work was curtailed and undertaking sponsored research was started. Because of the limited financial resources of local industries, much of the sponsored research undertaken so far has been at the request of the state sector organization like the Ministry of Fisheries, Mahaweli Authority etc.

Publications, Seminars and exhibitions are another important set of link mechanisms. The Centres resources do not permit the opportunity for a regular publication but the staff have contributed articles to scientific journals and newspapers. The Centre has been instrumental in organizing a number of Seminars both at the national and international level. It has also participated in a number of Exhibitions held in different parts of the country and abroad. This set of link mechanisms provide for the transfer of information right down to the grass root levels and therefore are very important both to the institution and to the country.

Since much of the commercializing activity of an institution hinges on mobilizing the interest of prospective entrepreneurs, collaboration with ongoing entrepreneur developed and business development programmes is vital. In Sri Lanka we are happy to have been associated with the entrepreneur development programme organized by the National Chamber of Small Industries and we have established in-formal links with other programmes such as the entrepreneur certificate programme of the Open University, work of the Business Development Centre and the Entrepreneur Development programme of the Industrial Development Board.

For projects that are suitable for commercializing on a distributed manufacturing basis, the level of success of current licence holders will greatly influence the number of future applications. In such instances the extent of the franchise type of services provided by the licenser and the build up of the demand for the product needs to be supplemented with guidance in business development and assistance in product promotion, specially on the national level. They say "Nothing suceeds like success" and in developing countries like Sri Lanka, it often happens there is spate of mushroom imitation manufacturers producing inferior quality products and under-cutting on price to the detriment of everybody. Unless patent protection is available, controlling the situation is very difficult and requires extensive field work and customer education.

Common bottle-necks to commercializing research results

Many developing countries have fallen into the trap of establishing research institutions without adequate provision of means for commercializing research results. The developed country model of a research institution passing on the results at the prototype stage for industry to continue the development and to set up production facilities,does not work in a developing country lacking industrial ability to do its own development, design and engineering for production. Even in the instance when the research institution is able to assist in all these stages upto planning production facilities, industrialists in developing countries often hesitate to commit funds and facilities to build up markets and absorb the likely initial losses since they operate on a short planning horizon as discussed earlier. Although complexity of the product and nature of the market for the product etc.will determine the actual cost for the different stages up to commercial introduction of the product, a rough estimate would be that development cost will be about 2-5 times research costs while the cost for setting up production will be 10-100 times the research costs. This large variation accounts for the possi- bility of the manufacturer using sub-contractors as opposed to large scale manufacture using certain amount of automatic machine systems. If the commercializing strategy calls for fast market penetration (so as to maximise benefits from patent/licence conditions that are time limited) commercial launch has to be accompanied with substantial investment in product promotion.

It is not unusual to devote about 15% of planned turn-over in the first few years for product promotion, this allocation being reduced to a level of about 7 1/2% on turn-over by the 5th year. The problem is further aggrevated in developing countries like Sri Lanka by the attitude of even the development banks which are quite adverse to lending money for innovative products since they do not have the facility to appraise technical and commercial feasibility of new products and processes. Not only is there a requirement for large amounts of funds to bridge the gulf between research results (prototype) and commercial success of a project but there are definite time spans for the respective stages of the project upto market success. In a situation where the cost of capital is very high, 'time is money', which further aggrevates the dilemma of project financing. Glib promotion by interested foreign parties and popular though somewhat wishful talk of "Leap frogging" developement processes, makes the public and the decision makers impatient with the commercialization process in real life. Even in developed countries major projects like nucleur power stations have a gestation period of about 10 years while a much simple project will have a gestation period of about 1 year. In the circumstances even a fairly simple project in a developing country can be safely assumed to take up to 2 years to reach commercial use. Where the project involves a complete re-design to be consistent with the factor endowments of the country a period of 3-5 years can be considered satisfactory except for very simple products where readily available materials & production processes can be applied.

For successful commercializing work sound technical background is very necessary together with a well developed business acumen. In addition there is a need for an abundant supply of optimism and endurance to be able to overcome bureaucratic red-tape, materials and machinery shortages, lack of skilled man-power, high inflation rates, etc. which are the common denomination in almost all developing countries.

A further problem faced by developing country persons engaged in commercializing research results stems from the inordinately high expectations of the local populaltion who wants the local products to be equal or better(sophisticated)than the imported products while at the same

time to be cheaper than the imported products. People who can only afford a bicycle costing Rs. 1500/- will yearn for a motor cycle costing Rs.15,000/- and not purchase the available and affordable bicycle. Most consumers in developing countries using the imported products as a yardstick in evaluating local products would look down on a locally manufactured television set if it had only two chanrel selectors whereas the imported product has (say) 12 channel selectors, being quite oblivious to the fact that in Sri Lanka there are only 2 broadcasting channels in operation.

What I have said so far may give you the impression that the R&D research institutions and those carrying out commercial activity have no shortcomings and that all the causes of our failures to achieve commercial success lie outside. This is not so and if we technologiests meeting here today continue to pat ourselves on the back and blame everybody else, we would only be fooling ourselves. Only by critically reviewing our performance can we look forward to improvement in the future.

One of the major failings the techonologists are prone to, is to be carried away with the technical excellence of the technological product or process, and not to be attuned to the commercial realities. On one extreme is the hurry to introduce a product to the market without sufficient attention being paid to prototype evaluation, field testing under actual user conditions, ironing out production problems or not building up adequate customer acceptance. The other extreme could be that the technologists who strive to make the perfect product from a sense of high technological achievement, quite forgetting that such a product cannot be sold because the cost will be excessive. This is aptly put in the saying "the better is the enemy of the good", meaning a product may be sufficiently well developed to be acceptable to the market at a given price and time, whereas further development of the product might mean the loss of the market due to either the product getting priced out of the market or a competing product capturing the existing market. This need for timing, pricing and building up customer acceptance no doubt have been bitter lessons to many of us in building up our business acumen.

Another major cause of failure at the commercializing stage is the shortcomings at the research project formulation stage. Common practice in a well planned industrial organization is for new product ideas to be evaluated on the basis of a thorough technical and market assessment. Close colloboration between marketing and the technical personnel is essential for producing commercially successful products. Since most research institutions in small size developing countries like Sri Lanka are constituted to work on specific stages of the research/development/ commercializing process they tend to cover a wide variety of subjects but not through all the stages of the commercializing process. This is the result of adhoc planning and over dependence on foreign consultants/aid donars who tend to favour the establishment of new institutions as a monument to their services. In Sri Lanka we have a number of research institutions and universities engaged in laboratory research work covering specific sectors, most of them in the field of agriculture. On the industrial side we have the Ceylon Institute of Scientific and Industrial Research which is represented by my colleague Mr. Mervyn Wijeratne, the National Engineering Research and Development Centre of Sri Lanka concentrating on all engineering aspects of project development and the Industrial Development Board concentrating on industrial extension. We also have 2 local development banks which are supposed to provide funds for development projects but in practice are no better than the other commercial banks when it comes to financing innovative projects and grass roots self employment programmes. Particular aspects of the situation are: the suspicious nature of most technologists who are afraid that their research results will be stolen by others; the "not our baby syndrome" meaning that projects originating from outside an organization are given only step motherly treatment; and the inevitable clash of personalities/identities of individual technologists/institutions. This problem has been well studied and there is now sufficient evidence to show that the "Product Champion", who champions the project when it passes through the different departments of the organization at different stages of the development process, is vital for the commercial success of the new product. I am sure many of you have been confronted with the situation of having a nice product for which there is no ready market. If market research and market development was planned to be in phase with the

technical development of the product, by the time production is ready to start, the market would also would be ready to absorb the product.

Case Study of the Prashakthi Project

Before I proceed to talk of national technology policies and regional collaborative action, I wish to take the opportunity to present a case study of one of our projects called "PRASHAKTHI'. I will confine myself to only one study, since it will be more illuminating to go into it in some depth so as to enable specific conclusions to be drawn rather than to cover many projects very briefly.

This project was selected for presentation not with an idea of boasting about our success but as we consider it to be an unique approach to solve a problem common to most of the developing countries in the region. On the other hand you might have been bored if I were to recount some of our failures since as I have already mentioned, much of the causes of our failures would be common knowledge to all of you.

PRASHAKTHI is actually a trade mark we had registered for a DC operated Fluorescent light using an electronic inverter circuit. The project was started in 1981. Initial work in modifying available electronic circuits to produce a satisfactory prototype required about 2 months. This was further developed to enable local manufacture by local technicians using locally available materials so as to satisfy the minimum functional requirements of a rural cottage. Minimising sales price was paramount. The basic system comprises of a 12 volt battery having a capacity of 45 amphrs. from which one or two small fluorescent lights are operated. The cost for such a set is approx. 25 US$ with only one light unit or US$ 30 with 2 light units. It is not my intention to go into the details of the technology assessment and the market assessment which resulted in the present specifications for the light units and the battery. I will rather elaborate on the commercializing aspects of the project. If any of you are interested in obtaining more information of the above mentioned aspects I have with me a few copies of a report by Mr. A.L.M. Perera Head

of our Techno Economics Section giving relevant details. At the start of commercializing this project, we had the following options -

a. to give wide publicity to the proposed lighting system and to make available designs to interested parties on a free of charge basis;
b. to transfer the research results to a large company on an exclusive basis;
c. to transfer technology to a limited number of manufacturers on an area basis.

Option (a) was dicarded since we had adopted similar approaches on two previous occassions when trying to popularise wind mills and solar water heaters, with disastrous results. From the response to the few inquiries made from established industrialists it was clear that they were not interested. They considered the special effort to build up a rural market, when the income level is very low, would not be profitable for them. When we advertised in the newspapers for prospective manufacturers, the response we had convinced us that option (c) was the most suitable for the project.

We had replies from about 50 prospective manufacturers from different parts of the country. From these applicants we finally selected 11 parties to whom the manufacturing technology and the right to use registered trade mark "PRASHAKTHI" was conferred, at a technology transfer seminar held in August 1981.

Some of the main provisions in the technology transfer agreement entered into on this occassion were as follows:-

a) We the licenser will provide complete technical information, training and continued technical assistance for the duration of the agreement period of 5 years, in all matters connected with the manufacture of Prashakthi light units.

b) The licenser will allow the use of the trade mark for the period of the agreement and thereafter if the agreement is not abrogated before the expiry of the agreement period.

c) The licensee will undertake to maintain confidential, information specific to the technology transfer, and to return all written/printed materials should the agreement be abrogated before its expiry date.

d) The licenser will provide full information on all future developments in connection with the Prashakthi lighting system.

e) The licensee should maintain recommended quality standards and give an year's guarantee on the products sold.

f) The licensee should pay an initial license fee and a royalty fee on sales for the duration of the agreement on account of the supply of technology and the facility to use the registered trade mark.

g) The licensee will take adequate steps to build up a minimum stipulated market for the products within 2 years of commencement of production.

The agreement also provided for the licenser to abrogate the agreement should the licensee -

a) willfully fail to maintain confidentiality of technological information received

b) if the licensee fails to pay the royalty dues according to the agreement

c) the licensee does not make adequate effort to build up the minimum stipulated market in the region allocated.

The criteria used to assess the suitability of the applicants can be briefly summarised as follows :-

a) application should live within the region for which application is made

b) he should possess a minimum capital of Rs. 10,000/- (approx. 400 US$) or proportionaltely less if he already possess some of the facilities required

c) either he should have had a secondary education in science or have had followed an electronics training course or have had experience in electronics or radio repair work

d) he should have a firm desire to set up his own business and be appreciative of the necessity to work hard to achieve success.

In the first instance all the applicants were sent a questionnarie to be filled and returned on the basis of which a selected number were invited for an interview. Those selected from the interview and who were agreeable to the terms stipulated in the technology transfer agreement, were finally selected. Following the 1981 technology transfer seminar, we have had 2 more technology transfer seminars the number of licensees appointed growing each time. We now have issued 62 licenses so far. Almost all major population areas have been covered accept in the north and eastern provinces where language problems have so far restricted our activities. Within the next year we hope to increase the number of licensees to about 120 thus adequately covering the full island. Seeing the extent of the success of some of our licensees many other imitation manufacturers have started up production. While we do not permit our licensees to sell in another licensees areas, we have no control over the imitation manufacturers. Most of them produce low quality products and sell at low prices, resulting in disrepute even for the Prashakthi light units. Quite a number of these manufacturers have applied to us for a license and have had to be turned down,since we already have a licensed manufacturer for the particular area.

Since the vast majority of the rural population used kerosene oil for domestic lighting,the government has been compelled to subsidise the price of kerosene as well as to provide limited quantity of kerosene as a free issue to about 1.5 million house-holds living on or below the subsistence level. Since the introduction of Prashakthi would allow the government to

save on the recurring subsidies and would help reduce the country's foreign exchange out lay on imported kerosene (approx. 80 million dollars per annum), we were able to obtain funds for a limited amount of product publicity on the national level. We were also able to obtain certain amount of funds to establish a revolving fund which we used to stock quality components required by our licensed manufacturers. We were thus able to ensure the continuity of supply of quality components and pass on to the small scale manufacturers also the economies of bulk purchasing. We have obtained certain components like transistors, fluorescent bulbs, etc. from highly competitive foreign sources while other items like plastic tube holders, etc. have been farmed out to local manufacturers, effecting considerable cost savings and providing opportunities for further local employment.

Regularly contact has been maintained with the licensed manufacturers who are provided guidance in the development of their business, in the improvement of their production facilities, on the scope and methodology of local product promotion and also assistance in preparing applications for bank loans/over drafts.

We have used the Prashakthi project as a launching pad to start off too more programmes :-

a) to locally manufacture battery chargers
b) to help establish battery charging centres

Both of these would generate self employment, further reinforce the popularization of Prashakthi and help to cut down foreign exchange expenditure by import substitution. To date we have issued about 25 licenses to manufacture battery chargers and we have registered about 100 battery charging centres which numbers are being continuously extended. Except for a few cases of licensees who obtained the license but did not actually start-up production and a few other loses when the licencee moved out of the area allocated to him, the number of business failures have been small (about 15%) even by international standards. While most of our licensees started as part-time manufacturers, many of them have now made it their full time business.

I would now like to draw some inferrances from this novel experience in commercialising research results. The first inference I like to draw is that mass markets for intermediate technological products do exist even in some small size developing countries like Sri Lanka and they can well be serviced by a network of rural manufacturers without the need for large scale automated production facilities for which foreign intervention would have been necessary. Although the existing product (kerosene oil lamp) which Preshakthi aims to replace is enjoying substantial government subsidies yet attempts to transfer the subsidies to a once and for all part payment against the purchase of Prashakthi cannot readily be implemented due to the inertia of the bureaucracy and consumer reservations to any changes in the government subsidy schemes. We also had to face hostility from other state sector organizations who felt we were intruding on their terriority whereas they should have been thankful that as a result of the success of our project, political pressures to undertake uneconomic programmes would be releived. The continued guidance in business development has enabled the growth of a number of viable techno enterprises in rural areas, many of whom have now effected further improvements in the product. Since we have still not got the full complement of licensees we have had to extend our business development services somewhat longer than earlier anticipated. We have found that the provision of such services has enabled us to ensure that royalties are paid regularly since there is a common tendency to evade such commitments specially among small industrialists in developing countries.

We feel that the project has been a commercial success in that we have received royalties amounting to more than 10 times what we had spent on research and development. Looking at the social benefits from the project which far out weigh the financial benefits, we are indeed sorry that we have not been able to further expedite the market penetration. On a rough estimate the social benefits would be more than 10 times the expenditure on market promotion. A proposal we have made to the economic planners for transferring the present kerosence subsidy is held-up, as some of them are still not convinced that the project is a success, while others seem to be of the opinion that if the project is a success there is no need for government assistance.

National Technology Policy with regard to Commercialising Research Results

Following from the excellent work done by UNIDO, UNCTAD, the need for technological self reliance in developing countries has now been accepted by most people. Unfortunately, proponents of the "Open Economy" system have confused the issue by mistakenly linking technological self reliance with technological isolation. To avoid such confussion I would prefer to use the term technological sovereignity. A study, carried out a few years ago by the Science Council of Canada, concluded that Canada - a major developed country - seemed to lack sovereignity over its technological development process. If it is so with Canada, how much worse will it be for small developing countries in Asia. At the early stages of technological sovereignity the stress would not be on the technological and scientific capacities but on the decision making autonomy for defining technology requirements, followed by acquisition and absorbtion. A somewhat more developed developing country might focus attention on the autonomous capacity for producing goods and services considered essential in its development strategy. Whatever the strategy and focus, to have control over technology is paramount since technology is one of the prime movers in the process of development. Technology can be said to consist of knowledge, skills experience and organization that is required to produce, utilize and control goods and services. The reknowned economist J.K. Galbrailh tracing the shift of power among the different factors of production, starts with the importance of land in the feudal times where property entailment ensured control in land ownership. With the start of the Industrial Revolution and the opening up of the New Worlds, Capital became the controlling factor. Next comes the entreprenour, whose fore-sight and ability were necessary to put together the different factors to form profitable ventures. Today he has been superceded by the large corporation since planning and organization required by modern technology is beyond the capacity of any single person. This entity,which embraces all who bring specialized knowledge, talent or experience to group decision - making within the large corporation, he called the Techno-Structure. Developing countries also like the major corporations (whose turnover could well be more than the GNP of many small developing countries) needs this techno structure if they are to benefit from todays technology.

It is no doubt futile to promote technological sovereighnity without recourse to planning and the preparation of policies which are linked to strategies of national development. Technology planning implies the existence of a formally constituted and internally consistant set of goals, objectives and instruments. For the majority of developing countries, the need to develop a technology planning capability is becoming increasingly urgent but experience has so far been dissapointing. Without technology planning a country will find it difficult to decide where the technological inputs need national development efforts, what items sought to be imported and what should be obtained from domestic sources. Also it will not be possible to ensure that the technological inputs are appropriate from the view-points of resource use, employment creation, income redistribution, needs satisfaction and environmental effects. In general, systematic progress towards the strengthening of endogenous capabilities and the substitution of appropriate domestic technologies for imported ones will be impossible without the existance of a broadly planned frame-work over a long period within which individual development projects can be fitted. Only very few of the developing countries can be said to have a technological intelligence, i.e, the capacity to appropriate and utilize knowledge. Technological intelligence is an essential component of and anticipatory intelligence, or the capacity of a nation to identity it's relevant strengths and weakness, to understand and analyse threats and opportunities of different kinds and to translate the resulting knowledge into policy and action.

In Sri Lanka where even national economic planning has been relegated to a rolling 5 years public sector investment plan with only a hazy expectation of the private sector investment component, technology planning up to now has been at a minimum. The government seems to have realized the gravity of the situation and steps have been taken to appoint a committee to go into this matter.

Some of the other features a National Technology Policy should take into consideration are :-

- invention promotion
- influencing technology demand

- converging needs with effective demand
- special fiscal and monetary incentives for innovative enterprises
- special provisions to ensure local technologists are given preference in technology contracts and that where foreign contractors are necessary that it should be mandatory that they work in collaboration with a local company/consultant
- promotion of a local technology consultancy capability
- promotion of self employment and techno-entrepreneurs
- policies of government purchases to reflect social benefits from distributed small scale manufacture and the upgrading of traditional technologies
- levy of a tax on imported technology products and services and utilising proceeds to promote local technology development and diffusion.

Regional Co-operation in Relation to the Innovative Functions

Stimulation of the creation and adaption of appropriate technologies presupposes selectivity in the international co-operation to support indigenous capacities for innovation. Thus developing countries should seek controlled co-operation rather than passive, economically channelled integration among themselves.

The distinction between co-operation and integration has to be made. The latter is a result of the uncontrolled workings of economic - primarily private - forces, with factor mobility across national borders. The former indicates a political attempt to guide and control the relations between the participating countries. Since the aim of the co-operation is to strengthen indigenous capacities for innovation through intensifying economic relations among the participating countries a co-operative scheme may easily turn into fostering integration in accordance with the interests of either the strongest of the participating states, or the strongest group of private business enterprises notably transnational corporations.

Therefore national industry and technical planning on a sectional basis should be the first pre-requisite for effective co-operation. The indigenous innovation capacity is necessary to enable a conscious continuous evaluation of the ways in which a country may acquire different types of technology and other inputs in the national innovation processes - through national investments, through importation from industrialised countries, through joint ventures with foreign enterprises, through co-operation among developing countries, or through a combination of these ways. The first step is to establish sectoral priorities for the technological transformation, based on the specific sectorial linkages in the country. Secondly an evaluation has to be made of gaps between actual and required capacities (technical, financial, institutional and social) for innovation in the selected sectors. The third planning step is to determine whether innovations can be attained through improvements in the indigenous capacity in other sectors or at other levels of society. Finally, bilateral or multilateral co-operation should be established in areas where the required capacity improvements cannot be obtained solely through national activities.

The appropriateness of possible partners for regional co-operation should be carefully scrutinized. It is not enough to belong to the same geographical region or sub region. The potential area and the contents of the co-operation should decisively influence the selection of partners. A genuine common interest should be at hand. Where similarities exist in identified needs/ problems and/or where there is a similarity in the available factor proportions or in the factors, a joint programme may be called for. Where complimentaries exist, a shared programme where each participant undertakes their part where he is most proficient in, so that the nett result would be to the mutual benefit of both,is the most appropriate. Technical co-operation between developing countries must be taken in the context of an overall economic co-operation programme. Where the flows of technical goods and services is predominantly in one direction, the recepient should be provided adequate avenues by appropriate barter provisions so as not to aggrevate foreign exchange difficulties and the ultimate ability to continue such purchases.

Where the differences are so big and one sided that they may lead to foreign dependence rather than mutual inter dependence, programmes like TCDC and ECDC might well be like 'going from the frying pan into the fire'.

Some possible areas where joint action may be desirable among suitable parters would be as follows:-

a) Joint programmes covering research and experimental development or engineering
b) Information and intelligence net works including research seminars, and political consultation
c) Joint training schemes
d) Exchange of know how and consultancy services including engineering, and management
e) Licensing, consultancy and other fields of techno economic co-operation
f) Research into the special nature and problems involved in innovation in developing countries
g) Collaborative effort to foster an awareness and build-up of the local expertise to carry-out technological planning

Conclusion

To conclude I would like to stress that technology could and should be the prime motive force of development rather than a passive follower. Neither technology nor the needs and problems of the developing countries remain constant. In many of our countries much work remains to be done on Technology Planning. This I think should be priority one both in terms of national action and from the point of view of regional and international support. Once national concensus - on where we want to go and what we want to do - is achieved much of the present problems encountered in commercialising research results will get resolved.